

ANNEX
BETWEEN
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
AND BLUE ORIGIN, LLC
UNDER SPACE ACT UMBRELLA AGREEMENT
NO. 29343, DATED 2/8/2020 (ANNEX NUMBER 21).

ARTICLE 1. PURPOSE

This Annex shall be for the purpose of The purpose of this reimbursable Annex is for NASA JSC to provide technical expertise to Blue Origin in the area of micrometeoroid orbital debris (MMOD) protection and risk assessment for the development of human-rated commercial space station technologies. This agreement is intended to advance the Partner's development of improved spacecraft protection for both MMOD shielding and windows for its commercial purposes. NASA JSC has the unique ability to perform MMOD analysis and risk assessments for spaceflight environments and has extensive experience in the development and analysis of spacecraft window systems for manned spaceflight vehicles.

This Annex will enable NASA JSC's Hypervelocity Impact Technology (HVIT) group to advise, assess, and develop analysis for the Partner over a 2-year period. Under this initial agreement, NASA JSC will provide the partner with expertise regarding NASA MMOD analysis capabilities, testing, requirements, and design, in addition to a specified number of MMOD impact test. NASA JSC will also provide the Partner with training on NASA's analysis software.

The legal authority for this Annex, consistent with the Umbrella Agreement, is in accordance with the Space Act, Other Transactions Authority (OTA), 51 U.S.C. § 20113(e).

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ARTICLE 2. RESPONSIBILITIES

A. NASA JSC will use reasonable efforts to:

1. Provide Blue Origin with access to NASA JSC's spacecraft MMOD experts, expertise, training, and knowledge base, to include mentoring/advice on ORDEM Version 3.2.0, MEM version 3, and BUMPER III.
2. Provide expertise to Blue Origin regarding design of MMOD shielding.
3. Provide MMOD analysis and risk assessment (including LOC risk) expertise on the following subsystems: windows, MMOD shielding, structure, thermal protection, and power.
4. Perform BUMPER III risk assessments and deliver input files and all risk assessment output files.
5. Provide recommendations on projectile particle size, velocity, obliquity, and material for Blue Origin's ballistic testing.
6. Participate in biweekly technical interchange meetings with Blue Origin.
7. Review and/or provide advice on Blue Origin test plans to generate MMOD shielding engineering data such as Ballistic Limit Equations.
8. Perform 12 MMOD impact tests.

B. Partner will use reasonable efforts to:

1. Provide Blue Origin spacecraft MMOD PNP and MMOD shielding requirements to NASA JSC.
2. Provide NASA JSC an overview of current analysis and testing procedures.
3. Provide NASA JSC with impact test materials and matrices for 12 impact tests.
4. Participate in biweekly technical interchange meetings with NASA JSC.
5. Provide engineering data from ballistic testing to NASA JSC.

ARTICLE 3. SCHEDULE AND MILESTONES

The planned major milestones for the activities for this Annex defined in the "Responsibilities" Article are as follows:

NASA JSC will provide Blue Origin with software training ED + 1 months

NASA JSC will advise Blue Origin on MMOD analysis ED + 2 months
and risk assessment of windows, MMOD shielding,
structure, thermal protection systems, and power systems

NASA JSC will perform BUMPER III risk assessments for Initial: ED + 6 weeks
initial Orbital Reef prototype

NASA JSC will perform BUMPER III risk assessments for Initial: 6 weeks after
Orbital Reef prototype assessment

	Updates: 6 weeks iterative from initial
NASA JSC will deliver all risk assessment inputs (script files) and all risk analysis outputs (Finite Element Models, Orbital Debris and Micro-Meteoroid flux models, LOC probabilities)	Initial: ED + 8 weeks Updates: 8 weeks iterative from initial
NASA JSC will perform 12 MMOD impact tests with test matrices and materials provided by Blue Origin	ED + 3 months
NASA JSC will provide Blue Origin with test plan reviews for ballistic testing	ED + 6 months
Technical interchange meetings	Biweekly
Project completion	ED + 1 year

ARTICLE 4. FINANCIAL OBLIGATIONS

A. Partner agrees to reimburse NASA an estimated cost of \$278,197 for NASA to carry out its responsibilities under this Annex.

Each payment shall be marked with Johnson Space Center Annex #21.

B. NASA will not provide services or incur costs beyond the current funding. Although NASA has made a good faith effort to accurately estimate its costs, it is understood that NASA provides no assurance that the proposed effort under this Annex will be accomplished for the estimated amount. Should the effort cost more than the estimate, Partner will be advised by NASA as soon as possible. Partner shall pay all costs incurred and have the option of canceling the remaining effort, or providing additional funding in order to continue the proposed effort under the revised estimate. Should this Annex be terminated, or the effort completed at a cost less than the agreed-to estimated cost, NASA shall account for any unspent funds within [insert timeframe, cannot exceed one year] after completion of all effort under this Annex, and promptly thereafter, at Partner's option return any unspent funds to Partner or apply any such unspent funds to other activities under the Umbrella Agreement. Return of unspent funds will be processed via Electronic Funds Transfer (EFT) in accordance with 31 C.F.R. Part 208 and, upon request by NASA, Partner agrees to complete the Automated Clearing House (ACH) Vendor/Miscellaneous Payment Enrollment Form (SF 3881).

ARTICLE 5. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

A. Data produced under this Annex which is subject to paragraph C. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement will be protected for the period of five years.

B. Under paragraph H. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement, Disclosing Party provides the following Data to Receiving Party. The lists below may not be comprehensive, are subject to change, and do not supersede any restrictive notice on the Data provided.

1. Background Data:

The Disclosing Party's Background Data, if any, will be identified in a separate technical document.

2. Third Party Proprietary Data:

The Disclosing Party's Third Party Proprietary Data, if any, will be identified in a separate technical document.

3. Controlled Government Data:

The Disclosing Party's Controlled Government Data, if any, will be identified in a separate technical document.

4. The following software and related Data will be provided to Partner under a separate Software Usage Agreement:

None

ARTICLE 6. TERM OF ANNEX

This Annex becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until the completion of all obligations of both Parties hereto, or two years from the Effective Date, whichever comes first, unless such term exceeds the duration of the Umbrella Agreement. The term of this Annex shall not exceed the term of the Umbrella Agreement. The Annex automatically expires upon the expiration of the Umbrella Agreement.

ARTICLE 7. RIGHT TO TERMINATE

Either Party may unilaterally terminate this Annex by providing thirty (30) calendar days written notice to the other Party.

ARTICLE 8. POINTS OF CONTACT

The following personnel are designated as the Points of Contact between the Parties in the performance of this Annex.

Management Points of Contact

NASA Lyndon B. Johnson Space Center
Eric L. Christiansen
Hypervelocity and Orbital Debris Office
Branch Chi
Mail Stop: XI5
2101 NASA Parkway
Houston, Texas 77058
Phone: 832-964-8599
Eric.L.Christiansen@nasa.gov

BLUE ORIGIN, LLC
Michelle Gray
Technical Program Manager
21218 76th Avenue S
Kent , WA 98032-2442
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Principal Investigator Point of Contact

BLUE ORIGIN, LLC
Nico Schwartz
Mechanical Engineer
21218 76th Avenue S
Kent , WA 98032-2442
Phone: 253-437-9300 x14742
nschwartz@blueorigin.com

ARTICLE 9. MODIFICATIONS

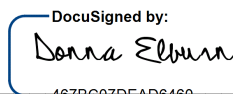
Any modification to this Annex shall be executed, in writing, and signed by an authorized representative of NASA and the Partner. Modification of an Annex does not modify the terms of the Umbrella Agreement.

ARTICLE 10. SIGNATORY AUTHORITY

The signatories to this Annex covenant and warrant that they have authority to execute this Annex. By signing below, the undersigned agrees to the above terms and conditions.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER

BY: _____
Burt Laws
Director of Exploration Integration and Science Directorate

BY:  _____
Donna Elburn
Director Of Procurement

DATE: _____

9/15/2022 | 1:49 PM PDT
DATE: _____